After Sales Technical Documentation

TACS SYSTEM OVERVIEW

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Cells

The Cellular System allows a large number of users to perform direct dialling from a cellular or portable telephone. The main difference between a cellular system and the older radio telephone systems is the re–use of the channels which allows more efficient use of the allocated frequency spectrum giving rise to a much larger number of users.

The cellular coverage area is divided into small areas known as 'cells', each of which is controlled by a cell site (base station) consisting of Low Power Transmitters, Receivers and Control Equipment. Each cell is allocated a proportion of the total number of channels and due to the relatively low transmission power and subsequent short transmission range, the same channel frequency can be used in a non–adjacent cell a short distance away. Typical cell sizes range from 2km to 30km in diameter, depending on the number of users in the area.

Groups of cell sites are connected to a central controller either by landlines or microwave links. The central controllers are known as Mobile Switching Centres (MSC). These are connected to each other, to the landline network and to a central computer which controls billing, administration and registration of new subscribers as well as maintaining system performance.

Channels

Cellular telephones are indirectly controlled by the MSC using a series of control and voice channels. Initially, system data is passed over control channels using digital signalling. Once a call is established, system information is passed over the Assigned Voice Channel using both digital and audio signalling.

Control Channels

Control Channels are divided into three groups as follows:

- Forward Control – provides basic system information such as the system status and range of channels. Also sets the telephone to the Scan Mode to find the Paging and Access Channels.
- Paging Channels – Holding place for idle cellular telephones.
- Access Channels – Used by the telephone when responding to a page or originating a call.

In many systems the three control channel functions are served by one channel for a particular cell. Multiple channels are only used in high density areas.

Voice Channels

Voice channels are used for both conversation and data transfer such as Hands–off, Telephone Output Power Control and special local control features.

Data transfer between the Cell Site and the telephone is at a rate of 8 kbits/s using FM. Data is formatted into groups of words with a binary preamble for synchronization purposes.

Tone Signalling

In addition to Digital Signalling, two signalling methods are used; a Supervisory Audio Tone (SAT) and a Signalling Tone (ST). The SAT is one of three frequencies centered on 6kHz, generated and sent by the Cell Site. The received SAT signal is transponded by the telephone on its assigned voice channel and is used to verify that the telephone is tuned to the assigned base station.

The Signalling Tone is a 8kHz tone generated and sent by the telephone on the assigned voice channel. It is used to acknowledge various cell site commands by varying the duration of the tone. For example, an ST of 50ms duration is decoded by the cell site as an acknowledgement of the Hand–off command.

Power–up Mode

On powering up, the telephone reads the fixed data in its memory before scanning the control channels. It selects and tunes to the control channel with the greatest signal strength and from this it receives the overhead control message. The message informs the telephone of the system to which it is tuned and the range of channels to scan for paging and access.

Idle Mode

The telephone scans the paging channels and selects and tunes to the strongest one, on which it receives continuous overhead and paging messages. The paging messages notify the telephone of incoming calls.

From this point the telephone continuously updates stored overhead message and monitors paging messages until it decodes its own telephone number, at which time it tunes to the strongest of the designated access channels.

Access

The telephone uses the access channel to acknowledge the paging message, at the same time notifying the system of its identification and cell location. The system responds by assigning a voice channel together with power level and SAT code information.

The telephone receives the command, tunes to the assigned voice channel, adjusts its transmitter power level, then transponds the SAT back to the cell site.

Reception of the transponded SAT indicates to the system that the telephone is on the correct channel and is ready to accept the call. An alert order is sent to the telephone which responds to the ST.

The telephone alert is activated (ringing tone) for 65 seconds or until the call is answered. On answering the call, the signalling tone is terminated and the audio paths are connected for conversation.

Transmitter Power Control

During a call, the system continuously monitors the transmitted signal strength of the telephone, and keeps it within set limits by sending transmitter power commands. The telephone converts the commands into transmitter power level settings which control the transmitter power output.

Hand–off

Hand–off occurs when the telephone reaches a cell boundary and is handed off to an adjacent cell. If the telephone is at maximum power and the received signal strength at the cell site is approaching the set minimum, the cell informs the MSC. The MSC commands the adjacent cells to monitor the signal strength of the telephone and hands off the call to the cell site reporting the strongest received signal.

Hand Off and Power Level changes are executed by interrupting the conversation with a burst of data containing the commands, which includes new voice channel SAT and power level.

The telephone acknowledges the Hand Off command by sending a signalling tone for a preset period before switching off its transmitter. The transmitter is off for a short period (approximately 250msec.) in order to re–tune both the transmitter and the receiver to the new voice channel, set SAT and power level prior to commencing transmission.

The Hand Off procedure is repeated as often as required in a call.

Call Termination

On termination of the call by the party calling the telephone, the MSC transmits, via the cell site, a release order which the telephone acknowledges by sending a signalling tone prior to ceasing transmission.

If the call is terminated by the user of the telephone, a burst of signalling tone informs the MSC to terminate the connection.

In either case, after call termination, the telephone returns to scanning the control channels, repeating the process performed when initially powered up.

Cellular Initiated Call

On initiating a call from the telephone, the telephone scans and tunes to the strongest access channel prior to sending an originating message containing its identity and the called number.

The MSC processes the called number, validates the caller and confirms the cell site to be used.

A voice channel is assigned to the telephone together with power level and SAT code information as described under the Access heading.

The call is terminated as described under the Call Termination heading.